

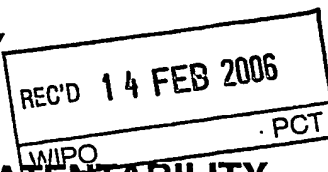
# PATENT COOPERATION TREATY


## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 110000/KR		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/NO2004/000330		International filing date (day/month/year) 01.11.2004	Priority date (day/month/year) 31.10.2003	
International Patent Classification (IPC) or national classification and IPC B23B29/02				
Applicant TEENESS ASA et al.				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 8 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  31.08.2005		Date of completion of this report  13.02.2006		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Meritano, L Telephone No. +49 89 2399-7311		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000330

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**Box No. 1 Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1, 3-12	as published
2, 2A	received on 05.09.2005 with letter of 31.08.2005

**Claims, Numbers**

1-23	filed with telefax on 23.01.2006
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**Drawings, Sheets**

1/7-3/7, 6/7, 7/7	as published
4/7, 5/7	filed with telefax on 23.01.2006

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/NO2004/000330

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-23
	No: Claims	
Inventive step (IS)	Yes: Claims	1-23
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-23
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. The subject-matter of claim 1 fulfils the requirements of Art. 33 PCT in view of the following.

The prior art is represented by known device for vibration damping and/or controlling the flexion of a tool, tool holder or workpiece during a machining operation, such as known from **US2002/0033083 (D1)** or **US-A-5 913 955 (D2)**.

The problem to be solved may be seen in finding a device suitable to work efficiently and to be applied to existing machine parts, in particular tools or tool holders, without modifying them.

The solution consists of using a force exchange device connected to the tool (or tool holder or workpiece) and to an external locating device surrounding the tool.

The actuators of **D1** and **D2** are located in recesses of the respective tools (see e.g. **D2**, figs. 1, 2): this saves space but requires a modified tool.

2. Claims 2 to 23 are dependent on claim 1 and as such fulfil the requirements of Art. 33 PCT as well.

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tool holder, thus weakening the tool. The materials oil and rubber are frequently used and they may be hard to obtain in a stable quality and they change properties with temperature and working life. In addition, such damping systems have limitations as to how low frequencies may be achieved. Also, twin mass dampers add an additional mass, hampering the balancing of tools rotating at a higher rpm.

Active dampening of tool holders may be achieved, for example, by using piezoelectric force actuators (see e.g. US Patent Application 2002/0033083 where piezoceramic elements are embedded in the tool holder). Such force actuators have previously been used i.a. in passive electrical dampers, such as in shunted force actuators in skis, tennis rackets and golf clubs. In active systems typically a piezoelectric force actuator is used which is bonded or otherwise attached to or within the tool holder. The actuator will then transmit the force to the tool via shear forces. A control system, typically an adaptive regulating system, controls the actuator force by means of information from a sensor, typically an accelerometer. In order to be able to damp vibrations in such a tool in the best possible way, the actuator has to be located close to the tool holder clamp. The problem associated with the said locations of actuators is the fact that they do not allow flexibility along the length of the overhang. Also, the force transmission to the tool will be inefficient since these shear forces have to be very large in order to resist motions farthest out on the tooth tip. US 5.913.955 is also an example of an embedded actuator system, where actuators are mounted in recesses cut into the bar surface.

The prior art comprises positioning of actuators directly onto or recessed in pockets on the tool holder, and the forces will then be transmitted from the actuator to the tool holder via shear forces. With such a clamping of actuators, one will be locked with respect to overhang lengths and force direction.

### Summary of the Invention

The invention solves or at least alleviates the problems of the prior art as referred to above.

According to the invention there is provided a device for vibration damping and/or controlling flexion of an object during machining, the device being distinguished by comprising at least one force exchange device for exchanging a force

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having a force component directed at right angle to the surface of the object and/or for exchanging directly or via a mechanical lever, a moment between the object and the device.

AMENDED CLAIMS

1. A device for vibration damping and/or controlling the flexion of an object  
(2, 10) in machining, wherein the object is a tool (2), tool holder (2) or  
5 workpiece (10),  
characterised in that the device comprises at least one force exchange  
device (7) external of a surface of the object, wherein said force exchange device  
(7) is attached to a locator device (4, 5, 14) surrounding the object (2, 10), and is  
operative to either  
10 exchanging a force having a force component directed at right angle to the  
surface of the object (2, 10), or  
exchanging directly or via a mechanical lever (3, 14), a moment between  
the object (2, 10) and the device.
- 15 2. A device according to claim 1,  
characterised in that the device further comprising a force transmission  
device (3) surrounding the object (2, 10).
3. A device according to claim 2,  
20 characterised in that the force exchange device (7) is disposed between  
a clamp (5) for the object (2) and the force transmission device (3), and is fixed to  
or recessed in the clamp (5).
4. A device according to claim 2,  
25 characterised in that the force exchange device (7) is disposed between  
the force transmission device (3) and the locator device (4).
5. A device according to any one of claims 1-4,  
characterised in that an elastic material (11) is disposed between the  
30 force transmission device (3) and the locator device (4).

6. A device according to claim 5,  
characterised in that the elastic material (11) is disposed between said  
at least one force transmission device (7) and the object (2, 10) or between said at  
least one force exchange device (7) and locator device (4).

5

7. A device according to claim 5 or 6,  
characterised in that the elastic material (11) is made from rubber.

8. A device according to claim 2,  
10 characterised in that the force exchange device (7) is configured to pro-  
vide a force having a force component at right angles to the force transmission de-  
vice (3) while also parallel to the surface of the object.

9. A device according to claim 2,  
15 characterised in that the force transmission device (3) is positioned  
between said force exchange device (7) and the object (2, 10).

10. A device according to claim 9,  
characterised in that the force transmission device (3) and said force  
20 exchange device (7) are positioned in the locator device (4).

11. A device according to claim 1,  
characterised in that the at least one force exchange device (7)  
exchanges a moment provided by a connector part for the object (2) for fixing the  
25 object (2) to a clamp (5) for the object.

12. A device according to claim 11,  
characterised in that said force exchange device (7) is positioned in the  
clamp (5) for the object (2).

30

13. A device according to any one of claims 1-12,  
characterised in that the device is movably disposed with respect to the  
object (2, 10).



14. A device according to any one of claims 1-13,  
characterised in that said at least one force exchange device is at least  
one actuator (7).

5 15. A device according to claim 14,  
characterised in that it comprises a control unit (8) for regulating input to  
the at least one actuator (7).

16. A device according to claim 15,  
10 characterised by a sensor (6) to be disposed on or in the object (2, 10)  
for detecting vibrations in and/or the flexion of the object (2, 10), said control unit  
(8) receiving signals from the sensor (6) for regulating the input based on said  
signals.

15 18. A device according to claim 16,  
characterised in that the sensor is an accelerometer.

19. A device according to any one of claims 14-16,  
characterised in that the actuator is a shaker, a pneumatic and hydrau-  
20 lic actuator, a piezoelectric force actuator or any other force, pressure or torsion  
actuator.

20. A device according to any one of claims 14-18,  
characterised in that the actuators are adapted to be passively control-  
25 led, said actuators being pneumatic dampers or shunted actuators, for example,  
and/or actively using a damping algorithm, for example.

21. A device according to any of the preceding claims,  
characterised in that the device is modular and permits use of different  
30 dimensions and geometrical configurations of the object (2, 10).

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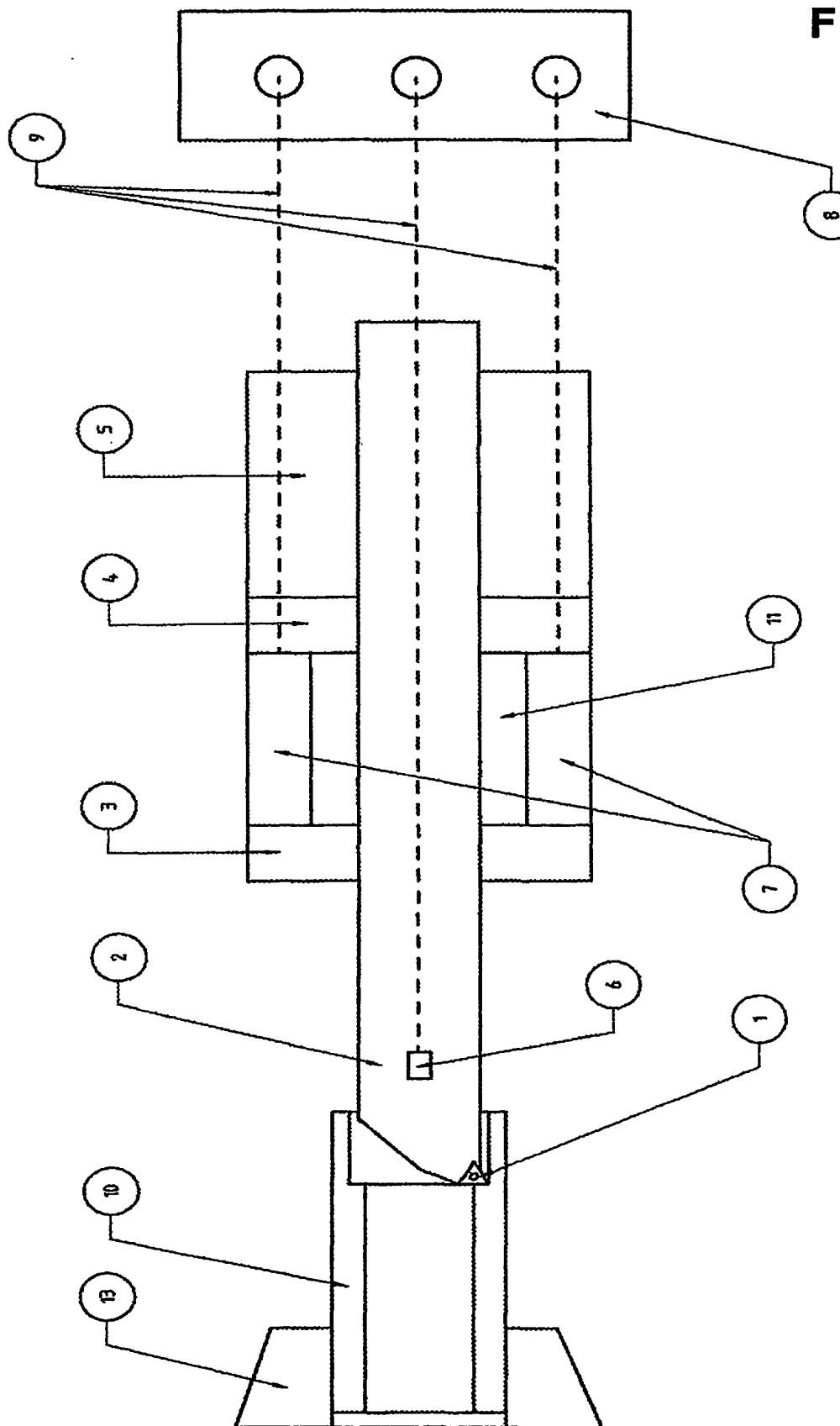
22. A device according to claim 1,  
characterised in that said at least one force exchange device is at least  
one force applying device (7) for applying said force and/or for applying said mom-  
ent to the object (2, 10).

5

23. A device according to claim 1,  
characterised in that said at least one force exchange device is at least  
one damping device (7) for absorbing vibrations from the object (2, 10), said dam-  
ping device (7) being adapted to absorb said force component and/or absorb said  
10 moment from the object (2, 10).

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**Fig. 4**



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Fig. 5

